



# Wave 1 Networking Standards: *Features and Functionality*

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# **Review: Open Architecture for Robots**

## ***Why Focus on Networking First?***

***GM Mission:*** Massive Integration of Robots Into a Mfg. System

***GM Focus:*** Decrease System Design and Integration Time  
Attain Aggressive Program Investment and Cost Targets  
Increase Success - on the First Try

***GM Priority:*** Open Interfaces

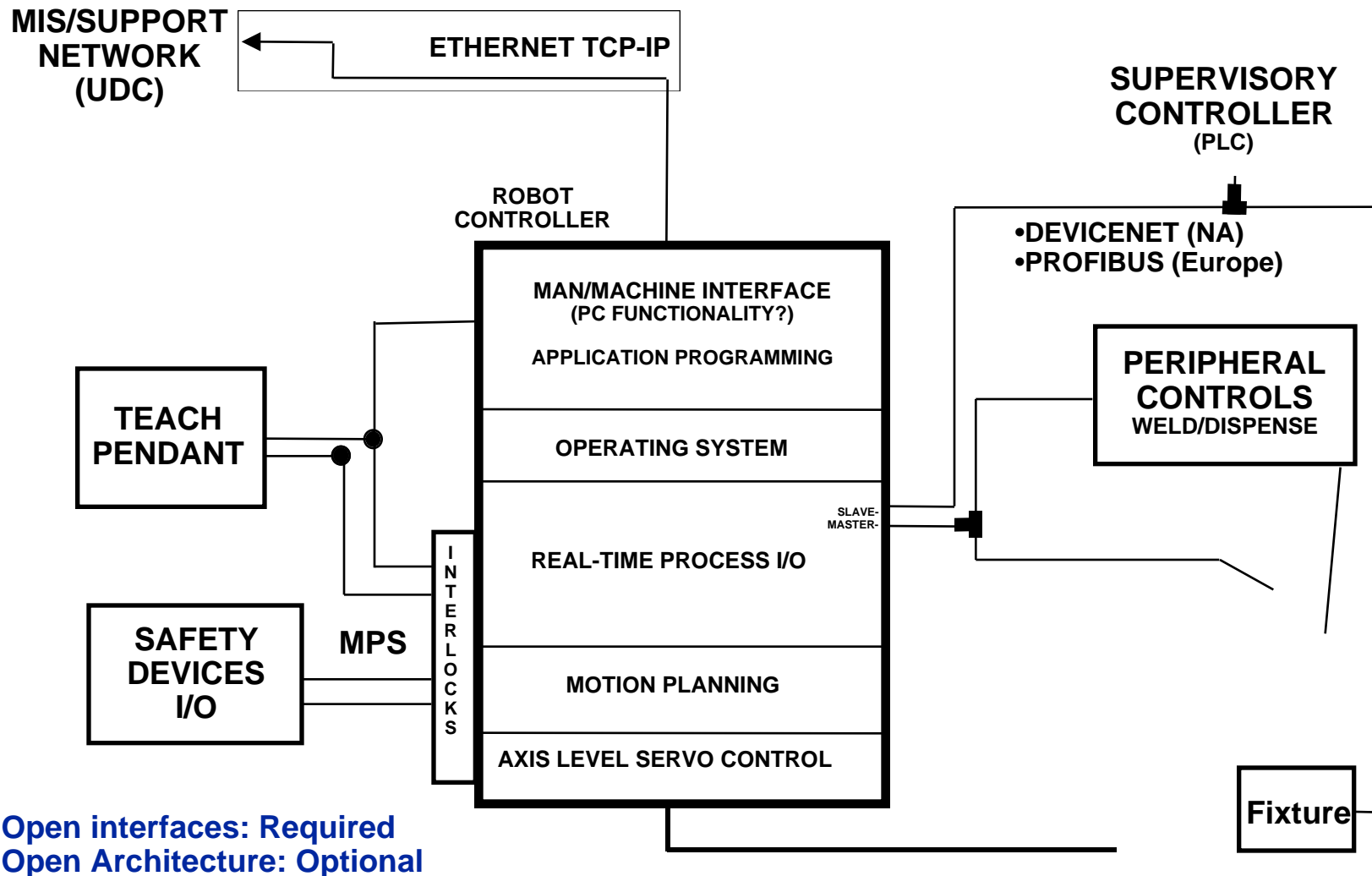
**Internal Controller Architecture Must Support Our Goals:**  
***Open or Proprietary!***

# ***Review: Open Architecture for Robots***

## ***Why Focus on Networking First?***

### **GM Priority: Open Interfaces**

- Current GM Specifications Focus on Open Interfaces and Validation
- Robot and Controller Seen As a System “Module”
- Robot Should “Plug and Play” Per GRS-1, RS-4 Specs
- Turn-key Software Application Function/Performance Built-in
- No Preference Shown for Specific Internal Architecture
- Movement to a PC Based Controller Left to Supplier Discretion
- Supplier Has Single Point Responsibility for Robot Performance
- GM Global Purchasing Process *Will Continue* to Drive Cost/function Benchmarks Down Irrespective of Controller Architecture





# **Review: Open Architecture for Robots**

## ***Why Focus on Networking First?***

### **Wave I Priority:** Robot Ethernet Network Interface

- GM Specification GRS-1 Outlines Required Functionality
- GM Strategic Robot Suppliers Support Most of GRS-1
- UDC (Upload, Download, Compare) Is Primarily Supported
- UDC Enables
  - Disaster Recovery
  - Change Monitoring
  - Plantwide Software Distribution
- UDC Widely Implemented in GM Plants
- Other Future Capabilities Are Enabled by This Interface
- Open UDC Not Widely Used in Industry
- Other Robot Interfaces Already Open (Devicenet, Profibus)



GM Robots Today

Wave I (Proposed)



# Wave 1 Networking Standards: *Proposed Supported Devices*

- Robots
- PLCs
- Weld Controllers
- HMI Devices
- PC Based Controls
- Soft PLCs
- No-Bots
- Drives



Proposed Std	GM Plants Today	Functionality - If Needed
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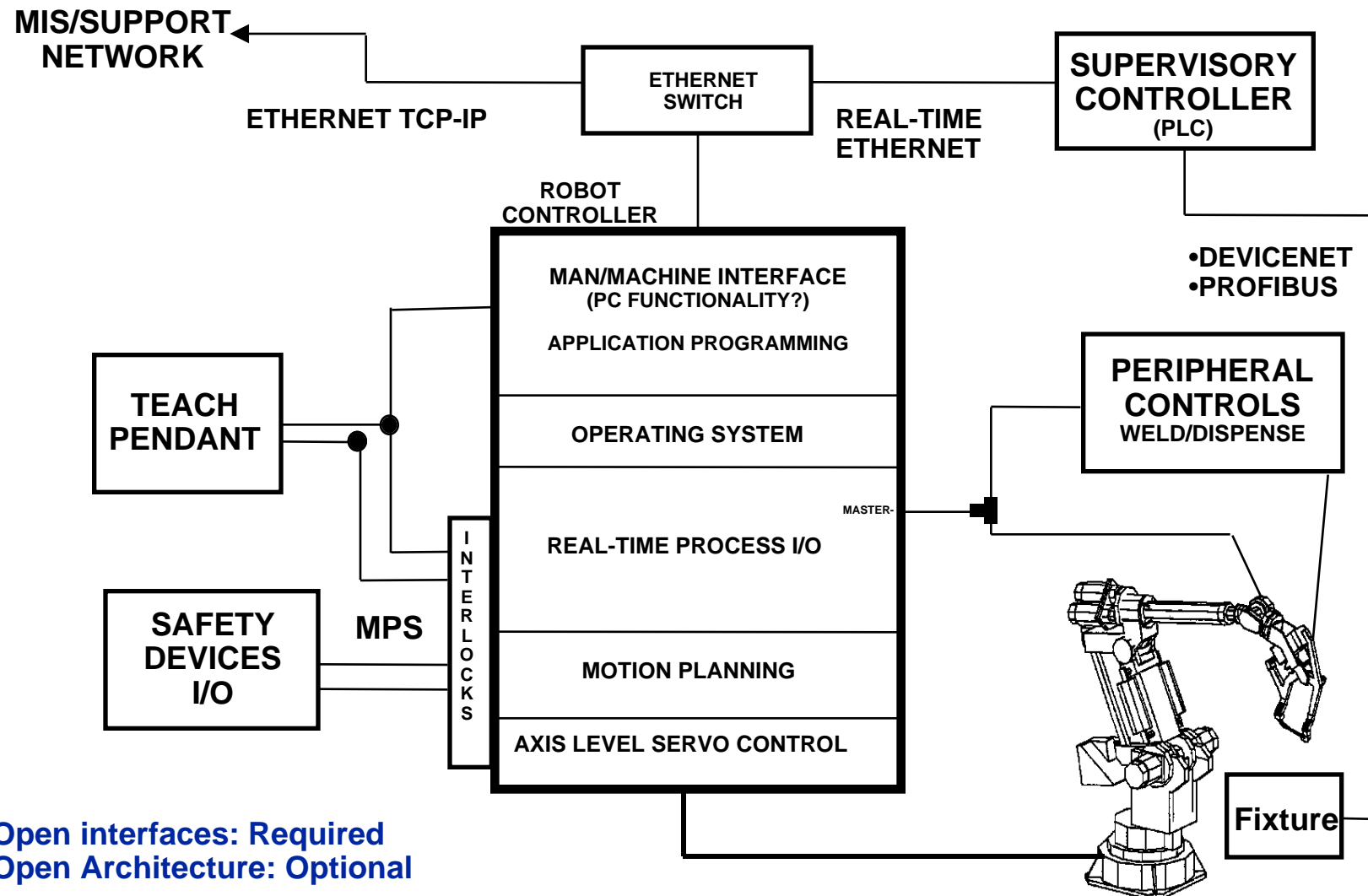


# Wave 1 Networking Standards: *Optional Features*

## *Wave 1 Optional Features ENABLE:*

- Buildshop Connectivity
- Data Collection / Distribution (depending on controller capability)
- Same Infrastructure as Data Collection, Monitoring Tools, Network Support
- Rapid Program Setup and Update
- Enhanced Configuration Change Monitoring / Change Control
- Complete Disaster Recovery (Including OS Load, and BIOS)
- Remote Diagnostics
- Real Time Ethernet

# Envisioned Controls Architecture



Open interfaces: Required  
Open Architecture: Optional

*RIA-NIST Open Architecture*



# Proposed Purchasing Language

## FTP

- For the application of file exchange, the application layer shall be implemented using file transfer protocol (FTP). Refer to RFC 959 for the official specification of the FTP.
- FTP shall be the protocol used for both directions of program file exchange.
- The robot controller shall act as both an FTP server and client for file transfer exchange.



## Proposed Purchasing Language

- **TCP** - The transport layer, which is used for transporting data from one end system to another end system, shall be implemented using TCP. Refer to RFC 793 for the official specification of the TCP.
- **IP** - The network layer, which is used for switching and routing network packets, shall be implemented using the IP. Refer to RFC 791 for the official specification of the IP.
- **802.3** - The data link layer, which is used for point-to-point frame relaying, shall be implemented using the ANSI/IEEE Standard 802.3
- **UTP** - Internal Ethernet wiring, if required, shall use Category 5 Unshielded Twisted Pair (UTP).